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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Appellants : Richard KELSO et al.

Group Art Unit: 1723

Appln. No. : 09/857,204

Examiner: D. L. Sorkin

Filed : September 18, 2001

For : FLUID MIXING DEVICE

APPEAL BRIEF UNDER 37 C.F.R. §1.192

Commissioner for Patents
PO Box 1450
Alexandria, VA 22313-1450

Sir :

This appeal is from the Examiner's final rejection of claims 1-9 and 20-37 as set forth in the Final Official Action of August 15, 2003.

A Notice of Appeal in response to the Final Office Action of August 15, 2003 was filed on February 17, 2004, and the two-month period for response was set to expire on April 19, 2004 (April 17, 2004 falling on a Saturday). Further, the instant Appeal Brief is accompanied by the requisite fee under 37 C.F.R. §1.17(c) in the amount of $330.00 for the filing of the Appeal Brief.

However, if for any reason the necessary fee is not associated with this file or the attached fee is inadequate, the Commissioner is authorized to charge the fee for the Appeal Brief and any necessary extension of time fees to Deposit Account No. 19-0089.

This Appeal Brief is being submitted in triplicate, pursuant to 37 C.F.R. §1.192(a).

(1) REAL PARTY IN INTEREST

The real party in interest is Luminis Pty., Ltd., as established by an assignment recorded in the U.S. Patent and Trademark Office on September 18, 2001, at Reel 012178 and Frame 0278.

(2) RELATED APPEALS AND INTERFERENCES

No related appeals and/or interferences are pending.

(3) STATUS OF THE CLAIMS

Claims 1-9 and 20-37 stand finally rejected and claims 10-19 stand objected-to. A copy of claims 1-37 is attached as an Appendix to this brief.

(4) STATUS OF THE AMENDMENTS

No amendments to the claims were filed under 37 C.F.R. §1.116 after the Examiner's final rejection of the claims of August 15, 2003.

(5) SUMMARY OF THE INVENTION

The present invention relates to a fluid mixing device for mixing fluids that may be flowing with variable directions and speeds. For example, the present invention can be used where one fluid is flowing and a second fluid is required to be mixed with the flowing fluid. (Specification, page 1, lines 4-11).

An exemplary fluid mixing device produces mixing characteristics that are resistant to changes in cross-flow direction and speed. The fluid mixing device may be a burner that provides a stable and continuous flame while being subjected to winds or draughts of widely variable direction and speed. (Specification, page 2, lines 15-21).

In an embodiment, the fluid mixing device includes a chamber formed of a cup. The chamber is closed at the open (upper) end by a bluff body. A (first) fluid inlet is disposed at the other (lower) end of the cup, and directs a gas flow toward the bluff body. (Specification, page 7, lines 1-7 and cross-sectional view of Figure 2). The bluff body includes at least one aperture (egress) for releasing fluid from the chamber. (Specification, page 7, lines 28-29 and page 9, line 26 to page 10, line 14).

A flow divider is provided in a region surrounding the bluff body. The flow divider defines at least one second fluid inlet and at least one mixed fluid outlet. The second fluid inlet(s) and mixed fluid outlet(s) can be a series of alternately arranged flow passages. The second fluid inlets and mixed fluid outlets may be symmetrically arranged at the same radius

about an axis of the fluid mixing device. (Specification, page 7, lines 13-26). Alternatively, the flow divider can include flow passages of different shapes and sizes. (Specification, page 8, line 27 to page 9, line 3).

A fluid flow from the first fluid inlet and/or the second fluid inlet(s) establishes a recirculating vortex system within the chamber. The vortex system is generated by the gas flow from the first fluid inlet. (Specification, page 8, line 1-4). The purpose of the bluff body is to deflect a proportion of the jet inlet flow radially outwards from the axis of the device, and so assist with forming the main internal vortex system which provides the mechanism for the flow recirculation. (Specification, page 9, lines 27-29). Furthermore, the internal flow pattern resists distortion from an external flow by using flow passages in such a way that the second fluid inlet(s) is subject to an approximately equal external pressure distribution, e.g., from the wind, as the mixed fluid outlet(s). (Specification, page 7, lines 19-23).

Accordingly, as described, the disclosed and claimed invention establishes a recirculating vortex system within a chamber, resulting in a mixture of fluids that is directed through mixed fluid outlets. Furthermore, as described, the disclosed and claimed invention includes first and second inlets and a mixed fluid outlet that are configured and positioned so that a fluid flow from the first fluid inlet and the second fluid inlet(s) establishes a recirculating vortex system within the chamber so that a first fluid and a second fluid are

mixed. As a result of the disclosed and claimed invention, a mixture can be stably provided to fuel a stable and continuous flame in a manner not previously available, even when the fluid mixing device is subject to winds or draughts of widely variable direction and speed.

(6) ISSUES

(A) Whether Claims 1, 20-23 and 25-37 are properly Rejected Under 35 U.S.C. §102(b) as Anticipated Over PATTERSON et al. (U.S. Patent No. 384,068);

(B) Whether Claim 24 is properly Rejected Under 35 U.S.C. §103(a) over PATTERSON et al. (U.S. Patent No. 384,068).

(C) Whether Claims 1-9 and 20-37 are properly Rejected Under 35 U.S.C. §102(b) as Unpatentable Over RYSCHKEWITSCH (U.S. Patent No. 2,044,511).

(7) GROUPING OF CLAIMS

For the purpose of this appeal, Appellants submit that none of the claims stand or fall together. Therefore, each of rejected claims 1-9 and 20-37 are separately patentable for the reasons set forth hereinbelow.

(8) **ARGUMENT**

(A) The Rejection of Claims 1, 20-23 and 25-37 Under 35 U.S.C. §102(b) as Anticipated over PATTERSON is Improper, and the Decision to Reject Claims 1, 20-23 and 25-37 on this Ground Should be Reversed. The Rejection of Claim 24 Under 35 U.S.C. §103(a) as Obvious Over PATTERSON et al. (U.S. Patent No. 384,068) is Improper, and the Decision to Reject Claim 24 on this Ground Should be Reversed.

In the Final Official Action of August 15, 2003, the Examiner rejected claims 1, 20-23 and 25-37 under 35 U.S.C. §102(b) over U.S. Patent No. 384,068 to PATTERSON. Appellants respectfully submit that the rejection of each of claims 1, 20-23 and 25-37 under 35 U.S.C. §102(b) over PATTERSON is improper and should be reversed. In this regard, Appellants hereinbelow first address the rejection of the independent claims under 35 U.S.C. §102(b) over PATTERSON in the numerical order of the claims.

(1) <u>Claim 1</u>

Claim 1 recites a "fluid flow from said first fluid inlet and/or from said second fluid inlet establishing a recirculating vortex system within said chamber and resulting in a mixture of fluids from said first fluid inlet and said second fluid inlet (s) being directed through said mixed fluid outlet (s)". Appellants respectfully submit that PATTERSON does not anticipate or suggest at least the above-noted features recited in claim 1, as required for the rejection

of claim 1 under 35 U.S.C. §102 to be proper.

In the outstanding Final Official Action, the Examiner states that "claim 1 additionally includes some discussion of what the claimed device is intended to do to a fluid intended to be used in the device". The Examiner then cites numerous cases (e.g., Hewlett-Packard Co. v. Bausch & Lomb Inc., 909 F.2d 1464, 15 USPQ2d 1525 (Fed. Cir. 1990); Ex parte Thibault, 164 USPQ 666 (Bd. App. 1969)) for the apparent proposition that the rejection of claim 1 under 35 U.S.C. §102 over PATTERSON is proper though PATTERSON does not explicitly disclose or suggest the above-noted feature of claim 1. Appellants' representatives conducted several telephone interviews with the Examiner to argue that a proper rejection under 35 U.S.C. §102 requires that each and every feature of the claimed invention be disclosed or suggested (inherent) in the reference applied by the Examiner. In this regard, in the final telephone interview on January 8, 2004, Appellants' representatives requested that the Examiner indicate in an Interview Summary whether the above-noted features are considered explicitly present in the references, whether the above-noted features are considered inherently present in the references, or whether the Examiner considers it unnecessary for the above-noted features to be present in the references.

Following the above-noted telephone interview with the Examiner and the Primary Examiner (who signed the above-noted Final Official Action), an Interview Summary was issued in which the Examiner first asserted that the above-noted features of claim 1 are

presumed to be inherent. Accordingly, because a §102 rejection is only proper if the reference applied by the Examiner explicitly or inherently discloses each and every feature recited in the claimed invention, Appellants hereinbelow address the rejection of claim 1 as if at least the "fluid flow" features at lines 5-8 of the claim are asserted by the Examiner to be inherent in PATTERSON (i.e., although the Final Official Action does not assert that such features are explicitly or inherently present in PATTERSON).

Appellants respectfully submit that the above-noted features recited in claim 1 are not inherent. In this regard, Appellants respectfully submit that the Examiner has not satisfied the burden of proof for a rejection based on inherency. In particular, "[u]nder the principles of inherency, if the prior art necessarily functions in accordance with, or includes, the claimed limitations, it anticipates." MEHL/Biophile Int'l Corp. v. Milgraum, 192 F.3d 1362, 1365, 52 USPQ2d 1303, 1305 (Fed. Cir. 1999). However, the fact that a certain result or characteristic may occur or be present in the prior art is not sufficient to establish the inherency of that result or characteristic. In re Rijckaert, 9 F.3d 1531, 1534, 28 USPQ2d 1955, 1957 (Fed. Cir. 1993) (emphasis in original). "To establish inherency, the extrinsic evidence `must make clear that the missing descriptive matter is necessarily present in the thing described in the reference, and that it would be so recognized by persons of ordinary skill. Inherency, however, may not be established by probabilities or possibilities. The mere fact that a certain thing may result from a given set of circumstances is not sufficient.'" In

re Robertson, 169 F.3d 743, 745, 49 USPQ2d 1949, 1950-51 (Fed. Cir. 1999).

Appellants note that it is the burden of the Examiner to show that the result asserted by the Examiner is the necessary result, and not merely a possible result. "In relying upon the theory of inherency, the examiner must provide a basis in fact and/or technical reasoning to reasonably support the determination that the allegedly inherent characteristic necessarily flows from the teachings of the applied prior art." Ex parte Levy, 17 USPQ2d 1461, 1464 (Bd. Pat. App. & Inter. 1990) (emphasis in original). However, in the above-noted Final Official Action, the Examiner has not even asserted any reasoning why the above-noted features recited in claim 1 would be possible in PATTERSON, let alone any basis in fact or reason to support the assertion that the above-noted features of claim 1 necessarily flow from the teachings of PATTERSON.

In any case, Appellants submit that the mere provision of structural features similar to those recited in claim 1 (i.e., a chamber, bluff body, first fluid inlet, flow divider, second fluid inlet and mixed fluid outlet), without regard to their arrangement and configuration, does not necessarily result in "a fluid flow from said first fluid inlet and/or from said second fluid inlet establishing a recirculating vortex system within said chamber and resulting in a mixture of fluids from said first fluid inlet and said second fluid inlet(s) being directed through said mixed fluid outlet(s)". Rather, a particular arrangement and configuration of the elements of the fluid mixing device is necessary to achieve the recited characteristics of

fluid flow. Furthermore, as is explained in the "Background Art" of the present specification at page 1, lines 19-21, flame stability was previously achieved in the background art by the generation of a flow recirculation or a vortex flow pattern either in the wake of a bluff-body or within vortex breakdown associated with strongly swirling flows (i.e., external to the chamber). However, there is no evidence that PATTERSON differs from the deficiencies of the background art described in the present specification. In any case, the Examiner has not provided any evidence that the above-noted features recited in claim 1 could result from the apparatus disclosed in PATTERSON, let alone that the above-noted features would necessarily result.

Additionally, with respect to Hewlett Packard, Appellants note that they are not trying to read unclaimed features into the claims. Rather, Appellants assert that the Examiner has effectively ignored features recited in claim 1 by reading such features out of claim 1. Furthermore, with respect to In re Ludtke and Sloan 169 USPQ 563 (CCPA 1971), Appellants were never put on notice before the second telephone interview that the Examiner considered the above-noted features to be inherent. In any case, Appellants submit that they have no reason to believe that the claimed characteristics are present in either reference applied by the Examiner; nor has the Examiner provided any reason to support an assertion that either of the references produces a "fluid flow from said first fluid inlet and/or from said second fluid inlet establishing a recirculating vortex system within said chamber", as recited

in claim 1. In this regard, there is little similarity in the structure shown in the figures of the present application (which can result in the claimed characteristics) and the structure shown in the references. Furthermore, as is noted in the present specification, the "internal flow pattern" of the present invention is "accomplished by distributing the second fluid inlets 11 and mixed fluid outlets 12 in such a way that they are both subjected to nearly the same external pressure distribution". See page 7, lines 19-24. In contrast, there is no disclosure in either reference of any configuration similar to that shown, by way of example, in the present specification. Accordingly, Appellants respectfully submit that no basis exists for any assertion that the above-noted features recited in claim 1 are inherent in the references applied in the Final Official Action.

Moreover, it appears that the Examiner has attempted to shift the burden of proof and expects Appellants to prove the negative proposition that PATTERSON (and RYSCHKEWITSCH) do not inherently possess the claimed features. However, without any evidentiary basis, let alone a proper evidentiary basis, for the assertion of inherency, such burden shifting is inappropriate. Further, without specifying the basis for the assertion of inherency, disproving the Examiner's position is an open-ended and unlimited proposition imposed on Appellants. In this regard, Appellants have no notice of, e.g., the specific conditions under which the Examiner believes the references would produce the recited features. Furthermore, because no basis in fact or reasoning was provided, Appellants have

no specific basis to refute the Examiner's assertion. Accordingly, Appellants respectfully submit that no proper basis has been provided to shift the burden of disproving the Examiner's proposition to the Appellants.

Moreover, with respect to Ex parte Thibault and In re Schreiber 44 U.S.P.Q.2d 1429 (Fed. Cir. 1997), Appellants note that the features recited in claim 1 (and claims 33 and 34) are not merely features of an "intended use". Rather, the above-noted features recited in claim 1 are positively recited characteristics of the elements of the mixing device. Furthermore, although not every feature shown in, e.g., Figures 1, 2 and 4 of, the present application is claimed, Appellants respectfully submit that the embodiments illustrated in the figures of the present application illustrate an apparatus that possesses the characteristics recited in claim 1. In comparison, as is noted below, the devices shown in the references applied by the Examiner are not similar (e.g., do not have the same "general shape" as in In re Schreiber) to the devices disclosed in the present application. Therefore, there is no reason to believe, nor has the Examiner set forth any reason to believe, that the devices of the references inherently possess the characteristics of the mixing device recited in claim 1.

In other words, the disclosure of the present application describes with particularity how a "recirculating vortex system" is established within a chamber. In this regard, PATTERSON does not describe or suggest a "recirculating vortex system" anywhere, let alone in the combination recited in claim 1. Rather, the diagram of fluid flows of Figure 1

of PATTERSON explicitly show only initial circulation of the liquid fuel and air, but not a recirculating vortex system.

Additionally, PATTERSON describes that "[t]he upper plate, H, is held upon supports J, which rest upon plate F, thereby forming a chamber or generator in which the vaporization of the hydrocarbon is effected and in which combustion takes place" (page 1, lines 61-65). Furthermore, PATTERSON explicitly describes that the combination of fuel and air occurs in the above-noted chamber between the upper plate H and the lower plate F. However, rather than describing a "recirculating vortex system", PATTERSON explicitly describes that "[t]he liquid fuel is held in check as it nears the outer periphery by" air passing through a region between the chamber and an inner periphery of a cylinder G (page 1, lines 81-90). Rather than disclosing the claimed "recirculating vortex system", Appellants respectfully submit that the above-noted disclosure of PATTERSON explicitly describes only the combination of air and fuel within a chamber. Accordingly, Appellants respectfully submit that the above-noted features recited in claim 1 are not anticipated (i.e., disclosed or inherent) in PATTERSON.

Appellants additionally assert that PATTERSON does not disclose or suggest a combination of "a first fluid inlet disposed toward an opposite end of the chamber from said bluff body and... a region substantially surrounding said bluff body including a flow divider defining at least one second fluid inlet to said chamber and at least one mixed fluid outlet

from said chamber", as recited in claim 1. In this regard, the lower plate F in PATTERSON is tapped at I to form the induction portion through which the liquid fuel passes into the chamber (see page 1, lines 51-54). Thus, the opening at point I in plate F could properly be described, in isolation, as the above-noted first fluid inlet recited in claim 1.

However, PATTERSON does not disclose or suggest the flow divider recited in claim 1. In particular, the only other inlets to the chamber as defined in PATTERSON are the two inlet ports K defined in the bottom plate F, for admitting a portion of air to the chamber (see page 1, lines 72-75). However, the bottom plate F is not in "a region substantially surrounding said bluff body", as recited in claim 1. Accordingly, the two inlet ports K in the bottom plate F are not defined by a flow divider in a region substantially surrounding the bluff body, as would be required if the two inlet ports K were considered to disclose the second fluid inlet(s) recited in claim 1. Furthermore, Figure 1 of PATTERSON does not disclose any other element in "a region substantially surrounding said bluff body" that could be considered "a flow divider defining at least one second fluid inlet to said chamber".

Appellants additionally note the Examiner's arguments at, e.g., page 11 of the Final Official Action dated August 15, 2003. In this regard, the Examiner has imposed artificial delineations onto Figure 1 of PATTERSON, in contrast with the direct teachings thereof, in an apparent attempt to modify the apparatus disclosed therein so as to impermissibly obtain the invention recited in claim 1 in hindsight. In this regard, the Examiner asserts that the

"chamber" in PATTERSON comprises the entire volume below the upper plate H, although PATTERSON describes, at page 1, lines 61-65, that the chamber is formed only between the lower plate F and the upper plate H.

The Examiner additionally asserts at page 11 that his artificial delineations are 'completely consistent with the usage of the word "chamber" in the instant specification' and "consistent with the intended use depicted by Patterson ('068) using arrows in Fig. 1 of the reference". The Examiner additionally invites a comparison of Figure 1 in PATTERSON with Figs. 4 and 9(a)-(c) of the instant specification. However, as is noted above, claim 1 recites "a fluid flow from said first fluid inlet and/or from said second fluid inlet establishing a recirculating vortex system within said chamber". In this regard, Figure 4 of the instant specification explicitly shows a recirculating vortex fluid flow within the disclosed chamber. In contrast, PATTERSON does not disclose or suggest anywhere that the fluid flows result in a recirculating vortex. Rather, the fluid flows shown in the burner of Figure 1 in PATTERSON only pass through each particular point in the system once. Moreover, there is no disclosure in PATTERSON that the flows include a "vortex". Accordingly, Appellants submit that the artificial "chamber" construed by the Examiner is neither a.) 'completely consistent with the usage of the word "chamber" in the instant specification' nor b.) "consistent with the intended use depicted by PATTERSON ('068) using arrows in Fig. 1 of the reference", in contrast to the Examiner's assertion related to the modifications of the

teachings of PATTERSON.

In summary, PATTERSON discloses a chamber between plates F and H, with an inlet at I, inlets at K, and outlets at J. However, PATTERSON does not disclose or suggest the recited "flow divider defining at least one second fluid inlet to said chamber" in "a region substantially surrounding said bluff body. Additionally, PATTERSON does not disclose or suggest "a fluid flow from said first fluid inlet and/or from said second fluid inlet establishing a recirculating vortex system within said chamber and resulting in a mixture of fluids from said first fluid inlet and said second fluid inlet(s) being directed through said mixed fluid outlet(s)". Accordingly, at least for each and all of the reasons set forth above, Appellants submit that the rejection of the invention recited in claim 1 should be reversed.

(2) Claim 33

Similar to the above-noted features recited in claim 1, claim 33 recites "said first and second inlets and said mixed fluid outlet being configured and positioned so that a fluid flow from said first fluid inlet and said at least one second fluid inlet establishes a recirculating vortex system within said chamber that mixes said first fluid and said second fluid". Appellants respectfully submit that the above-noted features of claim 33 are not disclosed or suggested by PATTERSON, at least for reasons similar to the above-noted reasons for the allowability of claim 1 over PATTERSON. In this regard, in the above-noted Final Official

Action, the Examiner had not even asserted that the above-noted features recited in claim 33 were inherent, let alone any basis in fact or reasoning to support the assertion that the above noted features were inherent in PATTERSON (and thus necessarily flowed from the teachings of PATTERSON). Moreover, the Examiner has not provided any evidence that the above-noted features recited in claim 33 could result from the apparatus disclosed in PATTERSON, let alone that the features would necessarily result. Accordingly, Appellants respectfully submit that the above-noted features recited in claim 33 are not anticipated in PATTERSON.

Appellants additionally assert that PATTERSON does not disclose or suggest a combination that includes "a region substantially surrounding said bluff body including a flow divider defining at least one second fluid inlet configured to provide a second fluid to said chamber and at least one mixed fluid outlet configured to emit a mixture of said first fluid and said second fluid from said chamber while said at least one second fluid inlet provides a second fluid to said chamber", as is recited in claim 33. In this regard, and as noted above, two inlet ports K are defined in the bottom plate F of PATTERSON. However, the bottom plate F of PATTERSON is not in "a region substantially surrounding said bluff body". Accordingly, the two inlet ports K are not the second fluid inlet as recited in claim 33. Furthermore, Figure 1 of PATTERSON does not disclose any other element in "a region substantially surrounding said bluff body" that could reasonably be considered a "flow

divider defining at least one second fluid inlet to said chamber". Accordingly, Appellants respectfully submit that PATTERSON does not disclose or suggest the above-noted features recited in claim 33.

Appellants additionally note that claim 33 was added during prosecution to ensure that the Examiner was fully considering the "fluid flow" features that are now asserted to be inherent. In this regard, Appellants added claim 33 to recite "said first and second inlets and said mixed fluid outlet being configured and positioned so that a fluid flow... establishes a recirculating vortex system within said chamber". In this regard, Appellants submit that the "structural" features of claim 33 are inseparable from the "functional" features, such that the functional language defines the structural relationships of the elements recited therein. Accordingly, even if features of claim 1 were properly ignored, Appellants respectfully submit that such features should not be ignored in the combination of claim 33.

Accordingly, at least for each and all of the numerous reasons set forth above, Appellants submit that the rejection of the invention recited in claim 33 should be reversed.

(3) Claim 34

Claim 34 recites "a fluid flow from said first fluid inlet and said at least one second fluid inlet establishing a recirculating vortex system within said chamber and a mixture of fluids from said first fluid inlet and said at least one second fluid inlet being emitted through

said mixed fluid outlet". Appellants respectfully submit that the above-noted features of claim 34 are not disclosed or suggested by PATTERSON, at least for reasons similar to the above-noted reasons for the allowability of claims 1 and 33 over PATTERSON. Accordingly, Appellants respectfully submit that the above-noted features recited in claim 34 are not anticipated explicitly or inherently in PATTERSON.

Appellants additionally assert that PATTERSON does not disclose or suggest a combination that includes "a region substantially surrounding said bluff body including a flow divider defining at least one second fluid inlet to said chamber that provides a second fluid and at least one mixed fluid outlet from said chamber that emits a mixed fluid", as is recited in claim 34, at least for reasons similar to the above-noted reasons for the allowability of claims 1 and 33 over PATTERSON. For example, Figure 1 of PATTERSON does not disclose any element in "a region substantially surrounding said bluff body" that could reasonably be considered a "flow divider defining at least one second fluid inlet to said chamber". Accordingly, Appellants respectfully submit that PATTERSON does not disclose or suggest the above-noted features recited in claim 34.

Accordingly, at least for each and all of the numerous reasons set forth above, Appellants respectfully submit that PATTERSON does not disclose or suggest the invention recited in claim 34.

(4) Claims 20-23, 25-32 and 35-37

Appellants additionally submit that claims 20-23, 25-32 and 35-37 are allowable, at least for the reason that these claims depend from claims 1, 33 and 34, respectively, and because these claims recite additional features that further define the present invention. Appellants further submit that claims 20-23, 25-32 and 35-37 are separately patentable over PATTERSON, which fails to disclose or render obvious, in the claimed combination, *inter alia*,

(i) the flow divider protrudes beyond said bluff body (claim 20);

(ii) wherein the flow divider extends into said chamber (claim 21);

(iii) wherein said first fluid inlet is spaced toward said bluff body from said opposite end of the chamber (claim 22);

(iv) wherein the spacing h of the first fluid inlet from said opposite end satisfies the relationship $0<h/L<1$

where L is the distance from the opposite end to the bluff body (claim 23);

(v) wherein said chamber is formed by a generally cup-shaped body with said bluff body disposed at or adjacent an open end (claim 25);

(vi) wherein said first fluid inlet is centrally disposed in the base of said cup (claim 26);

(vii) wherein said flow divider extends between the wall of said cup adjacent the open

end and said bluff body (claim 27);

(viii) wherein said flow divider is fixed to the wall of said cup (claim 28);

(ix) wherein said mixing device is a burner (claim 29);

(x) wherein said first fluid inlet supplies combustible fuel and said second fluid inlets supply air to the chamber (claim 30);

(xi) wherein said combustible fuel is a gaseous fuel (claim 31);

(xii) wherein said combustible fuel is a gaseous hydrocarbon fuel (claim 32);

(xiii) wherein a direction of fluid entry to said chamber from said first fluid inlet is substantially opposite a direction of fluid entry to said chamber from said at least one second fluid inlet (claim 35);

(xiv) wherein a direction of fluid entry to said chamber from said first fluid inlet is substantially opposite a direction of fluid entry to said chamber from said at least one second fluid inlet (claim 36);

(xv) wherein a direction of fluid entry to said chamber from said first fluid inlet is substantially opposite a direction of fluid entry to said chamber from said at least one second fluid inlet (claim 37).

For example, the cylinder C in PATTERSON is not a flow divider that "extends into said chamber", as recited in claim 21. Rather, the cylinder C in PATTERSON is provided around the chamber shown in Figure 1 of PATTERSON.

Moreover, the chamber defined in PATTERSON is not formed "by a generally cup-shaped body", as recited in claim 25. Rather, the chamber defined in PATTERSON is defined between two plates F and H in Figure 1 of PATTERSON. Additionally, PATTERSON does not disclose that a "flow divider extends between the wall of said cup adjacent the open end and said bluff body", as recited in claim 27, at least because PATTERSON does not disclose or suggest a cup or a "wall of said cup". Furthermore, it logically flows that PATTERSON does not disclose or suggest that a "flow divider is fixed to the wall of said cup", as recited in claim 28. Rather, the cylinder C in PATTERSON is provided entirely external to the chamber shown in Figure 1 of PATTERSON.

Additionally, the fluid entry from the induction port I is not in "substantially opposite a direction of fluid entry to said chamber from said at least one second fluid inlet", as recited in claims 35-37. Rather, the fluid entry from the ports K is in substantially the same direction as fluid entry from the induction port I in PATTERSON.

Accordingly, for all the above reasons, Appellants submit that the rejection of claims 1, 20-23 and 25-37 under 35 U.S.C. §102(b) is inappropriate and unsupported by PATTERSON et al. Therefore, Appellants respectfully request that the decision of the Examiner to finally reject claims 1, 20-23 and 25-37 under 35 U.S.C. §102(b) be reversed, and that the application be returned to the Examiner for withdrawal of the rejection over PATTERSON and an early allowance of claims 1, 20-23 and 25-37 on appeal.

(5) Claim 24

In the Final Official Action of August 15, 2003, the Examiner rejected claim 24 under 35 U.S.C. §103(a) over U.S. Patent No. 384,068 to PATTERSON. Appellants respectfully submit that the rejection of claim 24 under 35 U.S.C. §103(a) over PATTERSON is improper and should be reversed. In this regard, claim 24 recites "a fluid mixing device as claimed in claim 23 wherein the ratio h/L is about 0.4". In this regard, claim 23 recites "[a] fluid mixing device as claimed in claim 22 wherein the spacing h of the first fluid inlet from said opposite end satisfies the relationship 0<h/L<l

where L is the distance from the opposite end to the bluff body".

Appellants respectfully submit that PATTERSON discloses that the induction port I is formed "through [the] center" of the lower plate F. However, there is no disclosure that the pipe D should extend approximately 60% of the distance from the bottom plate F of the chamber to the top plate H of the chamber. Rather, inspection of Figure 1 in PATTERSON shows that the pipe D ends at the lower plate F, such that a comparable measure of h/L in PATTERSON (i.e., of the ratio of a distance from a first inlet to an opposite end compared to a total distance between the two ends of the chamber) would be approximately 1.

In the outstanding Final Official Action, the Examiner admits that numerical values are not discussed by the reference. However, the Examiner asserts that the h/L ratio is approximately .6. Appellants submit that such PATTERSON clearly discloses that the inlet

does not extend into the chamber, such that the ratio of h/L would be 1.

Furthermore, the Examiner asserts that it would have been obvious to one of ordinary skill in the art to have optimized the spacing of the inlet and/or the bluff body, to create a particular air flow. In this regard, the above-noted motivation is not a general motivation provided by PATTERSON; rather, the above-noted motivation is one that is only provided by the Examiner, in an attempt to reconstruct Appellants' invention in hindsight. In any case, as was discussed above at great length, PATTERSON does not disclose any reason why it would be desirable to create, e.g., a "recirculating vortex system within said chamber" (either the chamber explicitly disclosed in PATTERSON or the "chamber" as drawn by the Examiner in the Final Official Action), or any particular fluid flows that would be optimized by placement of the induction port I at a particular distance from the upper plate H. Therefore, for each of the reasons set forth above, Appellants respectfully submit that the rejection of claim 24 under 35 U.S.C. §103(a) over PATTERSON is inappropriate and unsupported by the teachings of PATTERSON. Therefore, Appellants respectfully request that the decision of the Examiner to finally reject claim 24 under 35 U.S.C. §103(a) be reversed, and that the application be returned to the Examiner for withdrawal of the rejections over PATTERSON and an early allowance of claim 24 on appeal.

(B) The Rejection of Claims 1-9 and 20-37 Under 35 U.S.C. §102(b) Over RYSCHKEWITSCH (U.S. Patent No. 2,044,511) is Improper, and the Decision to Reject Claims 1-9 and 20-37 on this Ground Should be Reversed.

In the Final Official Action of August 15, 2003, the Examiner rejected claims 1-9 and 20-37 under 35 U.S.C. §102(b) over U.S. Patent No. 2,044,511 to RYSCHKEWITSCH. Appellants respectfully submit that the rejection of each of claims 1-9 and 20-37 over RYSCHKEWITSCH is improper and should be reversed. In this regard, Appellants hereinbelow first address the rejection of the independent claims over RYSCHKEWITSCH in the numerical order of the claims.

(1) Claim 1

Claim 1 recites a "fluid flow from said first fluid inlet and/or from said second fluid inlet establishing a recirculating vortex system within said chamber and resulting in a mixture of fluids from said first fluid inlet and said second fluid inlet(s) being directed through said mixed fluid outlet(s)". In this regard, Appellants respectfully submit that RYSCHKEWITSCH does not anticipate or suggest at least the above-noted features recited in claim 1, as required for the rejection of claim 1 under 35 U.S.C. §102(b) over RYSCHKEWITSCH to be proper.

In the outstanding Final Official Action, the Examiner states that "claim 1 additionally

includes some discussion of what the claimed device is intended to do to a fluid intended to be used in the device". However, identical to the rejections over PATTERSON, the Examiner then cites numerous cases (e.g., Hewlett-Packard Co. v. Bausch & Lomb Inc., 909 F.2d 1464, 15 USPQ2d 1525 (Fed. Cir. 1990); Ex parte Thibault, 164 USPQ 666 (Bd. App. 1969)) for the apparent proposition that the rejection of claim 1 under 35 U.S.C. §102 over RYSCHKEWITSCH is proper though RYSCHKEWITSCH does not explicitly disclose or suggest the above-noted feature of claim 1. In this regard, the telephone interviews with the Examiner and the Primary Examiner (who signed the above-noted Final Official Action) resulted in an Interview Summary which first asserted that the above-noted features of claim 1 are presumed to be inherent in RYSCHKEWITSCH.

Appellants respectfully submit that the above-noted features recited in claim 1 are not inherent. In this regard, Appellants respectfully submit that the Examiner has not satisfied the burden of proof for a rejection based on inherency. Appellants note that it is the burden of the Examiner to show that the result asserted by the Examiner is the necessary result, and not merely a possible result. However, in the above-noted Final Official Action, the Examiner has not even asserted that the above-noted features recited in claim 1 were possible, let alone any basis in fact or reason to support the assertion that the above-noted features necessarily flow from the teachings of RYSCHKEWITSCH. In this regard, there is no evidence that RYSCHKEWITSCH differs from the deficiencies of the background art

described in the present specification (i.e., that generate a flow recirculation or a vortex flow pattern either in the wake of a bluff-body or within vortex breakdown associated with strongly swirling flows). Moreover, the Examiner has not provided any evidence that the above-noted features recited in claim 1 could result from the apparatus disclosed in RYSCHKEWITSCH, let alone that the above-noted features would necessarily result.

In other words, RYSCHKEWITSCH does not describe or suggest a "recirculating vortex system" anywhere. Rather, RYSCHKEWITSCH discloses, e.g., at page 2, column 1, lines 19-24, only that "the gaseous fuel streaming into the burner through the gas connection 2 draws in a certain amount of air and with the air entering at 11 burns completely in the combustion space lying between the ribs 7 and the inset body 8". The fluid flow resulting from the above-noted operation of RYSCHKEWITSCH is detailed in Figure 1 with arrows. However, similar to PATTERSON, RYSCHKEWITSCH explicitly shows and describes only initial circulation of fuel and air, but not a recirculating vortex system.

Additionally, claim 1 recites a "bluff body" and "a region substantially surrounding said bluff body including a flow divider defining at least one second fluid inlet to said chamber and at least one mixed fluid outlet from said chamber". In this regard, Appellants respectfully submit that the embodiment of Figures 1 and 2 in RYSCHKEWITSCH discloses a "housing" 1, an "inset body 8" that "can be arranged in the upper portion of the burner mouth", and "ribs 7". However, if the "chamber" in RYSCHKEWITSCH is considered the

entire space in the housing 1, then the "inset body 8" of RYSCHKEWITSCH is not a "bluff body defining one end of the chamber". Rather, the "inset body 8" merely defines almost the entire interior space of the "combustion space lying between the ribs 7 and the inset body 8" (see page 2, column 1, lines 19-24). Moreover, if the "chamber" in RYSCHKEWITSCH is considered the entire space in the housing 1, then the "ribs 7" cannot properly be considered a "flow divider defining at least one second fluid inlet to said chamber and at least one mixed fluid outlet from said chamber" recited in claim 1. Rather, the ribs 7 are entirely contained within the housing 1 such that a.) an outlet from the space in the housing 1 has to be provided separately from the ribs 7, and b.) an inlet to the space in the housing is provided by only the "openings 10" in the walls 4 (and not by the ribs 7).

Furthermore, if the above-noted "combustion space" in the embodiment of Figures 1 and 2 in RYSCHKEWITSCH (i.e., between the ribs 7 and the inset body 8) is considered the "chamber" recited in claim 1, then only a single inlet for mixed fluids is defined at the lower end of the chamber. Moreover, if the above-noted "combustion space" in RYSCHKEWITSCH is considered the "chamber" recited in claim 1, then a "flow divider defining at least one second fluid inlet to said chamber and at least one mixed fluid outlet from said chamber" is not provided in "a region substantially surrounding said bluff body", as recited in claim 1.

Additionally, the embodiment of Figures 3 and 4 of RYSCHKEWITSCH discloses

the "housing" 1 and "internal components 17" that are "annular and are supported from each other by radial ribs or distance pieces 18". However, Appellants respectfully submit that the "internal components 17" and "radial ribs or distance pieces" do not disclose "a bluff body defining one end of the chamber". Rather, the "internal components 17" and "radial ribs or distance pieces 18" are shown throughout most of the space in the "housing" 1.

Furthermore, the "internal components 17" and "radial ribs or distance pieces 18" are not described in detail. In this regard, there is no basis for describing any particular "internal component" or "radial rib" as a "bluff body", while distinguishing others of the "internal components 17" or "radial ribs or distance pieces 18" as "a flow divider defining at least one second fluid inlet to said chamber and at least one mixed fluid outlet from said chamber" as is recited in claim 1. In this regard, at page 12 of the Final Official Action, the Examiner asserted that "there is good reason to believe that central orifices would be outlets according to the intended operation, while radial outward orifices would be inlets". However, the Examiner has not provided Appellants with such "good reason", nor do Appellants believe any such reason exists. Additionally, the Examiner asserted at page 13, that '[w]hile the examiner certainly agrees that the meaning of the word "inlet" is essentially the opposite of the meaning of the word "outlet", they are only opposite in function, and may be identical in structure'. Appellants respectfully submit that the latter assertion of the Examiner can only be taken as an indication that the Examiner is considering the features recited in claim

1 in isolation, such that no weight is being given to the differences of an "inlet" and an "outlet" that are recited in the combination of claim 1.

In any case, Appellants respectfully submit that the Final Official Action arbitrarily assigns definition to the "internal components 17" and the "radial ribs or distance pieces 18" of RYSCHKEWITSCH merely in order to impermissibly obtain the invention recited in claim 1 in hindsight. In this regard, there is no teaching in RYSCHKEWITSCH that the elements 17 and 18 should be considered the "bluff body" and "flow divider" recited in the combination of claim 1.

Accordingly, Appellants respectfully submit that neither of the embodiments of RYSCHKEWITSCH discloses or suggests the combination of a "chamber", a "bluff body" and a "flow divider" recited in claim 1. Furthermore, Appellants respectfully submit that RYSCHKEWITSCH completely fails to disclose or suggest that a fluid flow from the inlets would establish "a recirculating vortex system within said chamber"as recited in claim 1.

(2) Claim 33

Appellants respectfully submit that the features of claim 33 are not disclosed or suggested by RYSCHKEWITSCH, at least for the numerous reasons similar to the above-noted reasons for the allowability of claim 1 over RYSCHKEWITSCH. Additionally, claim 33 was added to recite "at least one mixed fluid outlet configured to emit a mixture of said

first fluid and said second fluid from said chamber while said at least one fluid inlet provides a second fluid to said chamber". In this regard, Appellants respectfully submit that even if the disclosure in Figures 3 and 4 of RYSCHKEWITSCH included features that could be distinguished as an "inlet" and an "outlet", there is no teaching in RYSCHKEWITSCH that such features would operate as an "inlet" and an "outlet" at the same time in operation (i.e., "while"). Accordingly, in addition to the reasons for patentability set forth above with respect to claim 1, Appellants respectfully submit that claim 33 is not disclosed or suggested by RYSCHKEWITSCH at least because RYSCHKEWITSCH does not disclose a flow divider that defines both an inlet and an outlet in the manner recited in claim 33.

Furthermore, claim 33 recites a "second fluid inlet configured", "at least one mixed fluid outlet configured", and "said first and second inlets and said mixed fluid outlet being configured and positioned so that". In this regard, Appellants respectfully submit that the above-noted language recited in claim 33 was provided to ensure that the Examiner considered the functionality that is necessarily used to define the structural relationships of the elements recited in the claim, e.g., an "inlet" and an "outlet". However, as is noted throughout the present Appeal Brief, Appellants believe that the Examiner is not assigning patentable weight to various of the features recited in the present claims.

Accordingly, Appellants respectfully submit that neither of the embodiments of RYSCHKEWITSCH discloses or suggests the combination of a "chamber", a "bluff body"

and a "flow divider" recited in claim 33. Furthermore, Appellants respectfully submit that RYSCHKEWITSCH fails to disclose or suggest that a fluid flow from the inlets would establish "a recirculating vortex system within said chamber"as recited in claim 33.

(3) Claim 34

Appellants respectfully submit that the features of claim 34 are not disclosed or suggested by RYSCHKEWITSCH, at least for the numerous reasons similar to the above-noted reasons for the allowability of claim 1 over RYSCHKEWITSCH. Furthermore, claim 34 recites a "at least one second fluid inlet... that provides" and "at least one mixed fluid outlet... that emits". In this regard, Appellants respectfully submit that the above-noted language recited in claim 34 was provided to ensure that the Examiner did not confuse the features recited in claim 34 with features of "intended use". However, as is noted at page 14 of the Final Official Action, 'the examiner considers that nothing "affirmatively occurs" in any product, machine or composition claim', though the above-noted features recited in claim 34 clearly require that the "second fluid inlet... provides a second fluid" and that the "mixed fluid outlet... emits a mixed fluid". Therefore, Appellants respectfully submit that the Examiner is improperly ignoring the clear language recited in claim 34.

Accordingly, Appellants respectfully submit that neither of the embodiments of RYSCHKEWITSCH discloses or suggests the combination of a "chamber", a "bluff body"

and a "flow divider" (i.e., "defining at least one second fluid inlet... and at least one mixed fluid outlet") recited in claim 34. Furthermore, Appellants respectfully submit that RYSCHKEWITSCH fails to disclose or suggest that a fluid flow from the inlets would necessarily establish "a recirculating vortex system within said chamber"as recited in claim 34.

(4) Claims 2-9, 20-32 and 35-37

Appellants additionally submit that claims 20-32 and 35-37 are allowable, at least for the reason that these claims depend from claims 1, 32 and 33, respectively, and because these claims recite additional features that further define the present invention. Appellants further submit that claims 20-32 and 35-37 are separately patentable over RYSCHKEWITSCH, which fails to disclose or render obvious, in the claimed combination, *inter alia*,

(i) wherein said bluff body includes egress means for releasing fluid from said chamber (claim 2);

(ii) wherein said egress means include material porous to said fluids forming at least part of said bluff body (claim 3);

(iii) wherein said egress means include one or more apertures through said bluff body (claim 4);

(iv) wherein said bluff body includes a centrally disposed aperture (claim 5);

(v) wherein said first fluid inlet is directed substantially toward said centrally disposed aperture (claim 6);

(vi) wherein said aperture has a circular cross section (claim 7);

(vii) wherein said flow divider defines a series of flow channels which form said second fluid inlets and said mixed fluid outlets (claim 8);

(viii) wherein alternate ones of said flow channels spaced around said bluff body respectively form said second fluid inlets and said mixed fluid outlets (claim 9);

(ix) the flow divider protrudes beyond said bluff body (claim 20);

(x) wherein the flow divider extends into said chamber (claim 21);

(xi) wherein said first fluid inlet is spaced toward said bluff body from said opposite end of the chamber (claim 22);

(xii) wherein the spacing h of the first fluid inlet from said opposite end satisfies the relationship $0<h/L<l$

where L is the distance from the opposite end to the bluff body (claim 23);

(xiii) wherein the ration h/L is about .4 (claim 24);

(xiv) wherein said chamber is formed by a generally cup-shaped body with said bluff body disposed at or adjacent an open end (claim 25);

(xv) wherein said first fluid inlet is centrally disposed in the base of said cup (claim 26);

(xvi) wherein said flow divider extends between the wall of said cup adjacent the open end and said bluff body (claim 27);

(xvii) wherein said flow divider is fixed to the wall of said cup (claim 28);

(xviii) wherein said mixing device is a burner (claim 29);

(xix) wherein said first fluid inlet supplies combustible fuel and said second fluid inlets supply air to the chamber (claim 30);

(xx) wherein said combustible fuel is a gaseous fuel (claim 31);

(xxi) wherein said combustible fuel is a gaseous hydrocarbon fuel (claim 32);

(xxii) wherein a direction of fluid entry to said chamber from said first fluid inlet is substantially opposite a direction of fluid entry to said chamber from said at least one second fluid inlet (claim 35);

(xxiii) wherein a direction of fluid entry to said chamber from said first fluid inlet is substantially opposite a direction of fluid entry to said chamber from said at least one second fluid inlet (claim 36); and

(xxiv) wherein a direction of fluid entry to said chamber from said first fluid inlet is substantially opposite a direction of fluid entry to said chamber from said at least one second fluid inlet (claim 37).

For example, neither of the embodiments in RYSCHKEWITSCH discloses the second fluid inlet as defined in, e.g., claim 1, let alone that a direction of fluid entry to the chamber

from the first fluid inlet is substantially opposite a direction of fluid entry to the chamber from the second fluid inlet, as recited in claim 35 (and similarly recited in claims 36 and 37). Rather, each embodiment in RYSCHKEWITSCH only discloses an upward fluid flow of both the fuel and the air to the combustion space, and the embodiment of Figure 1 also discloses a lateral entry of air into the housing 1 through openings 7. However, neither embodiment discloses or suggests entry of fluid downward in opposition to the fluid entry from the "nozzles 3".

Furthermore, there is no disclosure in RYSCHKEWITSCH that any material is "porous to said fluids", as is recited in claim 3. Rather, even if the "inset body 8" were considered to disclose the "bluff body" recited in the claims, RYSCHKEWITSCH does not disclose or suggest any particular material for the "inset body" that would be considered "porous to said fluids".

Moreover, there is no basis for distinguishing the openings in Figure 4 of RYSCHKEWITSCH as inlets or outlets, let alone that "alternate ones of said flow channels... respectively form said second fluid inlets and said mixed fluid outlets" as recited in claim 9. In this regard, Appellants submit that it appears that the numerous annular internal components 17 of Figure 4 would not operate alternately as second fluid inlets and mixed fluid outlets without significant modifications to the burner in RYSCHKEWITSCH.

Accordingly, for all the above reasons, Appellants submit that the rejection of claims

1-9 and 20-37 under 35 U.S.C. §102(b) is inappropriate and unsupported by RYSCHKEWITSCH. Therefore, Appellants respectfully request that the decision of the Examiner to finally reject claims 1-9 and 20-37 under 35 U.S.C. §102(b) be reversed, and that the application be returned to the Examiner for withdrawal of the rejection over RYSCHKEWITSCH and an early allowance of claims 1-9 and 20-37 on appeal.

Accordingly, Appellants submit that the rejection of claims 1, 20-23 and 25-37 under 35 U.S.C. §102(b) is inappropriate and unsupported by the teachings of PATTERSON et al. Appellants further submit that the rejection of claims 1-9 and 20-37 under 35 U.S.C. §102(b) is inappropriate and unsupported by the teachings of RYSCHKEWITSCH. Appellants further submit that the rejection of claim 24 under 35 U.S.C. §103(a) is inappropriate and unsupported by the teachings of PATTERSON. Therefore Appellants respectfully request that the decision of the Examiner to finally reject claims 1-9 and 20-37 under 35 U.S.C. §102(b) and/or 35 U.S.C. §103(a) be reversed, and that the application be returned to the Examiner for withdrawal of the rejections over PATTERSON and RYSCHKEWITSCH and an early allowance of claims 1-37 on appeal.

(9) CONCLUSION

Claims 1, 20-23 and 25-37 are patentable under 35 U.S.C. §102(b) over PATTERSON; claims 1-9 and 20-37 are patentable under 35 U.S.C. §102(b) over

RYSCHKEWITSCH; and claim 24 is patentable under 35 U.S.C. §103(a) over PATTERSON. Specifically, the applied art of record fails to disclose, suggest or render obvious the unique combination of features recited in Appellant's claims 1-37. Accordingly, Appellants respectfully request that the Board reverse the decision of the Examiner to finally reject claims 1-9 and 20-37 under 35 U.S.C. §102(b) or 35 U.S.C. §103(a) and return the application to the Examiner for withdrawal of the rejections.

Thus, Appellants respectfully submit that each and every pending claim of the present application meets the requirements for patentability under 35 U.S.C. §102 and 35 U.S.C. §103, and that the present application and each pending claim are allowable over the prior art of record.

Should there be any questions, any representative of the U.S. Patent and Trademark Office is invited to contact the undersigned at the below-listed telephone number.

Respectfully submitted,
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APPENDIX

1. (Original) A fluid mixing device including a chamber, a bluff body defining one end of the chamber, a first fluid inlet disposed toward an opposite end of the chamber from said bluff body and arranged to direct fluid toward said bluff body, a region substantially surrounding said bluff body including a flow divider defining at least one second fluid inlet to said chamber and at least one mixed fluid outlet from said chamber, a fluid flow from said first fluid inlet and/or from said second fluid inlet establishing a recirculating vortex system within said chamber and resulting in a mixture of fluids from said first fluid inlet and said second fluid inlet (s) being directed through said mixed fluid outlet (s).

2. (Original) A fluid mixing device as claimed in claim 1 wherein said bluff body includes egress means for releasing fluid from said chamber.

3. (Original) A fluid mixing device as claimed in claim 2 wherein said egress means include material porous to said fluids forming at least part of said bluff body.

4. (Original) A fluid mixing device as claimed in claim 2 wherein said egress means include one or more apertures through said bluff body.

5. (Original) A fluid mixing device as claimed in claim 4 wherein said bluff body includes a centrally disposed aperture.

6. (Previously Presented) A fluid mixing device as claimed in claim 5 wherein said first fluid inlet is directed substantially toward said centrally disposed aperture.

7. (Original) A fluid mixing device as claimed in claim 6 wherein said aperture has a circular cross section.

8. (Previously Presented) A fluid mixing device as claimed claim 1 wherein said flow divider defines a series of flow channels which form said second fluid inlets and said mixed fluid outlets.

9. (Original) A fluid mixing device as claimed in claim 8 wherein alternate ones of said flow channels spaced around said bluff body respectively form said second fluid inlets and said mixed fluid outlets.

10. (Original) A fluid mixing device as claimed in claim 9 wherein said flow divider has a corrugated profile so as to repeatedly cross said region surrounding the bluff body.

11. (Previously Presented) A fluid mixing device as claimed in claim 10 wherein said chamber includes an outer wall extending substantially around the perimeter of said region surrounding the bluff body.

12. (Original) A fluid mixing device as claimed in claim 11 wherein said corrugated profile alternately contacts the bluff body and said outer wall.

13. (Previously Presented) A fluid mixing device as claimed in claim 12, wherein the geometric center of a cross-section of each of the flow channels defined by said corrugated profile is substantially equidistant from the bluff body and from the outer wall.

14. (Previously Presented) A fluid mixing device as claimed in claim 12, wherein the

geometric centers of the cross-section of each of the flow channels defined by said corrugated profile are alternately substantially closer to the outer wall and substantially closer to the bluff body.

15. (Previously Presented) A fluid mixing device as claimed in claim 14 wherein the flow channels having cross-sections with geometric centers substantially closer to the outer wall form said second fluid inlets and the flow channels having cross-sections with geometric centers substantially closer to the bluff body form said mixed fluid outlets.

16. (Previously Presented) A fluid mixing device as claimed in claim 10 wherein said corrugated profile is of triangular form so that said flow channels are generally triangular in cross section.

17. (Original) A fluid mixing device as claimed in claim 16 wherein at least alternate flow channels have substantially the same cross section size.

18. (Original) A fluid mixing device as claimed in claim 17 wherein said corrugated profile defines eight flow channels forming second fluid inlets each alternately interposed with eight flow channels forming mixed fluid outlets.

19. (Original) A fluid mixing device as claimed in claim 18 wherein the mixing device has eight-fold azimuthal symmetry about a longitudinal axis.

20. (Previously Presented) A fluid mixing device as claimed in claim 1 wherein the flow divider protrudes beyond said bluff body.

21. (Previously Presented) A fluid mixing device as claimed in claim 1 wherein the flow divider extends into said chamber.

22. (Previously Presented) A fluid mixing device as claimed in claim 1 wherein said first fluid inlet is spaced toward said bluff body from said opposite end of the chamber.

23. (Previously Presented) A fluid mixing device as claimed in claim 22 wherein the spacing h of the first fluid inlet from said opposite end satisfies the relationship $0<h/L<1$

where L is the distance from the opposite end to the bluff body.

24. (Original) A fluid mixing device as claimed in claim 23 wherein the ratio h/L is about 0.4.

25. (Previously Presented) A fluid mixing device as claimed in claim 1 wherein said chamber is formed by a generally cup-shaped body with said bluff body disposed at or adjacent an open end.

26. (Original) A fluid mixing device as claimed in claim 25 wherein said first fluid inlet is centrally disposed in the base of said cup.

27. (Previously Presented) A fluid mixing device as claimed in claim 25 wherein said flow divider extends between the wall of said cup adjacent the open end and said bluff body.

28. (Original) A fluid mixing device as claimed in claim 27 wherein said flow divider is fixed to the wall of said cup.

29. (Previously Presented) A fluid mixing device as claimed in claim 1 wherein said

mixing device is a burner.

30. (Original) A fluid mixing device as claimed in claim 29 wherein said first fluid inlet supplies combustible fuel and said second fluid inlets supply air to the chamber.

31. (Original) A fluid mixing device as claimed in claim 30 wherein said combustible fuel is a gaseous fuel.

32. (Original) A fluid mixing device as claimed in claim 30 wherein said combustible fuel is a gaseous hydrocarbon fuel.

33. (Previously Presented) A fluid mixing device including a chamber, a bluff body defining one end of the chamber, a first fluid inlet disposed toward an opposite end of the chamber from said bluff body and arranged to direct a first fluid toward said bluff body, a region substantially surrounding said bluff body including a flow divider defining at least one second fluid inlet configured to provide a second fluid to said chamber and at least one mixed fluid outlet configured to emit a mixture of said first fluid and said second fluid from said chamber while said at least one second fluid inlet provides a second fluid to said chamber, said first and second inlets and said mixed fluid outlet being configured and positioned so that a fluid flow from said first fluid inlet and said at least one second fluid inlet establishes a recirculating vortex system within said chamber that mixes said first fluid and said second fluid.

34. (Previously Presented) A fluid mixing device including a chamber, a bluff body

defining one end of the chamber, a first fluid inlet disposed toward an opposite end of the chamber from said bluff body that directs a first fluid toward said bluff body, a region substantially surrounding said bluff body including a flow divider defining at least one second fluid inlet to said chamber that provides a second fluid and at least one mixed fluid outlet from said chamber that emits a mixed fluid, a fluid flow from said first fluid inlet and said at least one second fluid inlet establishing a recirculating vortex system within said chamber and a mixture of fluids from said first fluid inlet and said at least one second fluid inlet being emitted through said mixed fluid outlet.

35. (Previously Presented) The fluid mixing device of claim 1, wherein a direction of fluid entry to said chamber from said first fluid inlet is substantially opposite a direction of fluid entry to said chamber from said at least one second fluid inlet.

36. (Previously Presented) The fluid mixing device of claim 33, wherein a direction of fluid entry to said chamber from said first fluid inlet is substantially opposite a direction of fluid entry to said chamber from said at least one second fluid inlet.

37. (Previously Presented) The fluid mixing device of claim 34, wherein a direction of fluid entry to said chamber from said first fluid inlet is substantially opposite a direction of fluid entry to said chamber from said at least one second fluid inlet.